JOURNAL OF APPLIED BEHAVIOR ANALYSIS 1981, 14, 351-355 NUMBER 3 (FALL 1981)

ELEVATION OF VOICE VOLUME IN YOUNG DEVELOPMENTALLY DELAYED CHILDREN VIA AN OPERANT SHAPING PROCEDURE

LOUIE FLEECE, ALAN GROSS, THOMAS O'BRIEN, JANET KISTNER, ESTHER ROTHBLUM, AND RONALD DRABMAN

UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

Unusually low voice volume was identified by teachers as a significant impediment to the academic and social progress of two preschool students. A simple operant shaping procedure was conducted by teachers to increase voice volume using a voice-activated apparatus with attractive visual display. Setting generalization of volume increases to the classroom was achieved and maintained at one- and four-month follow-ups.

DESCRIPTORS: voice volume, speech, feedback, voice-operated relay, preschool children

Garcia (1974) outlined two steps necessary to produce more adequate verbal responding in language deficient persons. First, imitative learning must be established (Baer, Peterson, & Sherman, 1967), and second, speech that is functional within the individual's social environment must be developed (Sloane, Johnson, & Harris, 1968). In order for verbalizations to be considered functional they should include intelligible content within adequate structure and, obviously, must also be spoken loudly enough to be understood.

A few studies are reported in the literature in which attempts were made to raise voice volume in children and chronic adult psychiatric patients. Schwartz and Hawkins (1970) successfully increased the voice volume of a "maladjusted" sixth grader using a delayed reinforcement paradigm within a multiple-baseline design but provided only very brief follow-up data (4 wk). Blake and Moss (1967) increased voice volume in an electively mute child with numerous behavior problems via a shaping procedure. A "color organ" apparatus on which the intensity of color shown on the visual display corresponded to the voice volume emitted by the child served as the reinforcing stimulus during shaping. Jackson and Wallace (1974) successfully increased the voice volume of a 15-yr-old "severely disturbed" girl using a voice-activated relay system to identify suprathreshold responding during a shaping procedure using token reinforcement. Increases did not generalize, however, from the laboratory to a classroom reading setting without additional contingencies. Finally, Patterson, Teigen, Liberman, and Austin (1975) shaped increases in voice volume for three chronic adult psychiatric inpatients using social and edible reinforcers administered contingently for suprathreshold responses measured by a voice-activated relay apparatus. Voice volume data from the apparatus were directly available only to experimenters. Partial maintenance of treatment gains was observed at several month follow-ups, but the authors explained the need for environmental support for full long-term maintenance of treatment effects.

The current study attempted to increase voice volume among very young (4- to 5-yr-old) developmentally delayed children. A simple operant shaping procedure was conducted by a classroom teacher using feedback from a sound sensitive apparatus with visual display located in the

Requests for reprints should be sent to Ronald S. Drabman, Department of Psychiatry and Human Behavior, University of Mississippi Medical Center, 2500 North State Street, Jackson, Mississippi 39216.

training setting. Setting generalization of volume increases to the classroom was assessed and the social validity of treatment effects achieved was examined. This study differs from previous experiments attempting to increase voice volume in several respects. First, subjects were preschool children rather than disturbed adolescents (Jackson & Wallace, 1974; Schwartz & Hawkins, 1970) or chronically institutionalized adults (Patterson et al., 1975). Secondly, the current experiment successfully produced and objectively measured substantial increases in voice volume in a generalization setting devoid of additional programmed reinforcement contingencies. Patterson et al. (1975) relied exclusively on anecdotal data to access ward generalization of laboratory increases and noted that the ward environment was insufficiently reinforcing of volume increases to maintain them at several months follow-up. Jackson and Wallace found little generalization of laboratory volume increases to the classroom without additional contingencies. Thirdly, the current study includes objective generalization setting follow-up data whereas only anecdotal data are reported by Patterson et al. (1975) and Jackson and Wallace (1974).

METHOD

Participants and Setting

Two children participated in the present experiment. Crystal was a 4-yr-old girl who passed most of the age-appropriate nonverbal items on the Vineland but who demonstrated extreme shyness, social withdrawal, delayed speech, and very low voice volume. Her records indicated that because of these problems, intelligence testing could not be completed. Franklin was a 5-yr-old boy with a Stanford-Binet IQ of 73 whose slow intellectual development was identified early and qualified him for special preschool programs. Like Crystal, Franklin demonstrated extreme shyness, social withdrawal, and very low voice volume. Both children could speak in short meaningful sentences but were extremely difficult to understand because of their low volume. They were enrolled in a private preschool setting specializing in children with physical and/or intellectual developmental disabilities or delays. The preschool setting featured a high teacher-student ratio (approximately 2:6) and highly structured preacademic activities.

Operant approaches to both instruction and classroom behavior management were in routine use by all teachers. Both children were identified by their teachers as children for whom unusually low voice volume had become a significant impediment to academic and social development. However, each child did possess a normal vocal apparatus as assessed by physical exam.

Design and Procedure

A multiple-baseline design across subjects was used to test effects of training procedures on performance in the classroom generalization setting. During the treatment phase, each child was removed from the classroom by the teacher and seated in a sound-attenuated room (measuring approximately 1.5 m $\times$ 2.5 m $\times$ 2.5 m). Each child was seated .5 m from a sound sensitive apparatus with a visual display (measuring approximately 15 cm $\times$ 12 cm) comprised of red and green lights arranged to resemble a Christmas tree. Similar to apparatus used by Blake and Moss (1967) and Strang and George (1975), apparatus used in the current experiment included a voice-activated relay with adjustable sensitivity which determined at what volume level the visual display would light. Prior to baseline, each child had been taken several times by an experimenter to the room and asked to recite a list of 10 words which pupils typically used in class. Neither the teachers nor the experimenters noticed any effect from these sessions which were held without the presence of the visual display.

In treatment training sessions, the teacher asked the children to choose one of nine nursery rhymes (involving words similar to those used in prebaseline activities) to recite. Nursery rhymes were selected because they provided a relatively

standard vocabulary and speech length and because reciting them was an activity in which most of the class could participate. Although a particular rhyme could be chosen more than once, each child was required to recite a number of rhymes over the course of the study. The teacher attempted to shape increases in voice volume by altering the sensitivity of the voice-activated relay. It was hoped that illumination of the colorful visual display would serve as a reinforcer for successive approximations to an appropriate voice volume. Although performance feedback (e.g., "You didn't light the tree that time") was given, social reinforcement of volume increases was specifically excluded. Training sessions were conducted for 15 min, approximately twice per week.

During the baseline and treatment phases, several children including the participants were individually asked to select and recite one nursery rhyme in the presence of the remainder of the class (6-10 children). These recitations took place approximately twice a week 1 to 2 hr after the training sessions and lasted about 20 min.

To assess the effects of treatment in the classroom generalization setting, voice volume during nursery rhyme recitation was noted on a labeled 0 to 20 scale. These assessments during both baseline and treatment phases were conducted in the classroom either by the children's classroom teacher and a naive independent observer or by two naive independent observers. All independent observers were blind to experimental phases and objectives. Reliability was assessed during each session. Two school office employees functioned as the independent observers. Additional independent observers were sometimes present in the classroom collecting volume data on children (some with normal voice volume) not included in the present experiment.

A rating of 0 represented "usually inaudible" volume, a rating of 5 indicated volume that was "usually too soft," a rating of 10 equaled "usually normal" volume, a rating of 15 indicated that volume was "usually too loud" and a rating of 20 indicated the child was "usually screaming." Independent observation of normal voice volume children yielded ratings of 9 to 11. Volume rating represented average volume level during the rhyme rather than the maximum or minimum levels. No specifically programmed social reinforcement was provided by the staff during classroom generalization sessions. This procedure permitted naturalistic assessment in that targeted verbal responses were representative of routine preacademic classroom tasks and responses occurred amidst typical ambient noise levels in the classroom. Follow-up data at 1 and 4 mo were obtained in the generalization setting using assessment procedures identical to those described above.

RESULTS

Classroom generalization setting volume data from the multiple-baseline design across subjects are presented in Figure 1. Session data in Figure 1 represent an average voice volume rating based on scores assigned by two raters. After a baseline mean of .6 with no ratings approaching normal volume on the 0 to 20 volume scale, treatment was begun first for Crystal. The overall treatment phase mean for Crystal was 7.2 with an average of 9.75 over the final eight assessment sessions, which closely approximated normal volume. Baseline voice volume levels for Franklin averaged 3.2. Volume rose to an average of approximately 8.0 during the treatment phase with a mean of 9.7 for the final three assessment sessions. Follow-up voice volume data were obtained for both children at 1 and 4 mo. Crystal produced volume levels closely approximating normal volume (9.25-10.0) which were quite consistent with levels recorded during the latter sessions of the treatment phase. One month follow-up data for Franklin (7.5) approximated his treatment phase mean, but a further increase (10.0) was recorded at 4 mo.

Pearson product-moment correlations between the classroom teacher and independent observers ($r = .90$) and between independent observers ($r = .87$) were calculated as measures

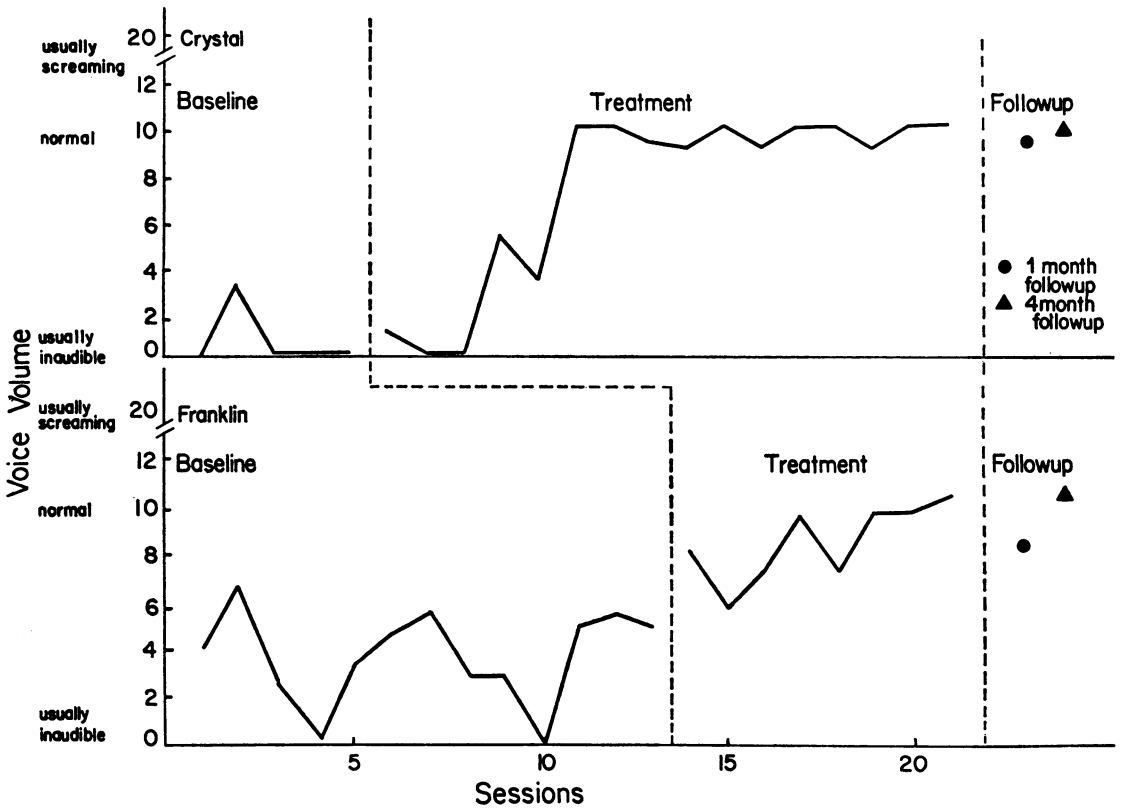

Fig. 1. Average voice volume levels in the classroom generalization setting per assessment session.

of interrater reliability of voice volume ratings during classroom assessment sessions.

DISCUSSION

The present study reports a successful effort to elevate voice volume of children with developmental delays. The multiple-baseline design across subjects demonstrated the controlling effects of the training procedure on classroom generalization setting voice volume levels. Although the classroom teacher conducted training and also participated in generalization assessments, the presence of classmates and other experimental personnel, far higher ambient noise levels, and radically different physical surroundings in the classroom strongly suggest the present results can legitimately be termed setting generalization (Drabman, Hammer, & Rosenbaum, 1979). Training procedures were felt to be simple and practical in terms of staff time and equipment requirements.

Social validity issues (Wolf, 1978) are also important to the evaluation of this study. Certainly acquisition of functional speech which necessarily entails adequate voice volume is of paramount importance for young children to increase verbal preacademic classroom learning and social contacts with peers. Anecdotal reports from two independent classroom observers (school office workers), who contributed no data to the present experiment, suggest that volume increases achieved generalized to everyday speech for both children, contributing broadly to their continued academic and social development. At the end of training, Crystal was able successfully to complete a Stanford Binet IQ test achieving a score of 93. At the end of the school year Crystal "graduated" from the special school

with the recommendation that she be placed in a regular educational setting.

REFERENCES

Baer, D. M., Peterson, R. F., & Sherman, J. A. The development of imitation by reinforcing behavior similar to a model. *Journal of the Experimental Analysis of Behavior,* 1967, **10,** 405-416.

Blake, P., & Moss, T. The development of socialization skills in an electively mute child. *Behaviour Research and Therapy,* 1967, **5,** 349-356.

Drabman, R. S., Hammer, D., & Rosenbaum, M. S. Assessing generalization in behavior modification with children: The generalization map. *Behavioral Assessment,* 1979, **1,** 203-219.

Garcia, E. The training and generalization of a conversational speech form in nonverbal retardates. *Journal of Applied Behavior Analysis,* 1974, **7,** 137-149.

Jackson, D. A., & Wallace, R. F. The modification and generalization of voice loudness in a fifteen-year-old retarded girl. *Journal of Applied Behavior Analysis,* 1974, **7,** 461-471.

Patterson, R. L., Teigen, J. R., Liberman, R. P., & Austin, N. K. Increasing speech intensity of chronic patients ("mumblers") by shaping techniques. *The Journal of Nervous and Mental Disease,* 1975, **160,** 182-187.

Schwartz, M. L., & Hawkins, R. P. Application of delayed reinforcement procedures to the behavior of an elementary school child. *Journal of Applied Behavior Analysis,* 1970, **3,** 85-96.

Sloane, H. N., Johnson, M. K., & Harris, F. R. Remedial procedures for teaching verbal behavior to speech deficient or defective young children. In H. N. Sloane & B. D. Mac Aulay (Eds), *Operant procedures in remedial speech and language training.* Boston: Houghton Mifflin Co., 1968.

Strang, H. R., & George, J. R. Clowning around to stop clowning around: A brief report on an automated approach to monitor, record, and control classroom noise. *Journal of Applied Behavior Analysis,* 1975, **8,** 471-474.

Wolf, M. M. Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis,* 1978, **11,** 203-214.

Received August 25, 1980
Final acceptance February 11, 1981